

*Stated Meeting, December 21, 1866.*

Present, seventeen members.

Dr. WOOD, President, in the Chair.

Mr. R. P. Uhler, a member of corresponding Society, was introduced.

Letters were read from the Holland Society of Sciences, at Harlem; from the Literary and Philosophical Society of Manchester, April 14; from the Society of Natural Sciences at Marburg, September 28, 1866, announcing the transmission of donations, and from the Imperial Geographical Society of St. Petersburg, July 25 and August 6, 1866; from the Imperial Geological Institute at Vienna, April 26, 1866; from the Royal Academy at Brussels, Nov. 20, 1865; from the Royal Academy at Amsterdam, Nov. 23, 1865; from the Physical Society at Berlin; from the Royal Society at Göttingen, March 22, 1866; from the Royal Belgian Academy, November, 1865, and February 14, 1866; from the Royal Geological Society of Ireland, November 29, 1865; from the Museum of the Antiquaries of Scotland, January and February, 1866; from the Society of Antiquaries of London, February 2, 1865, and August 4, 1866; from the Essex Institute of Salem, Mass., July 5, 1866; from the Massachusetts Historical Society, April 2 and August 29, 1866; from the Public Library at Boston, September 12, 1866; from the American Antiquarian Society at Worcester, Mass., July 5 and July 11, 1866; from the University of Toronto, March 19, 1866; from the Buffalo Natural History Society, November 22, 1866; from the Historical Society of Chicago, March 20, 1866; from the American Oriental Society of New Haven, March, 1866; from the New York Historical Society, July 5 and July 11, 1866; from the New Jersey Historical Society, July 5, 1866, and from the Historical Society of Pennsylvania, June 25 and July 18, 1866, severally acknowledging the receipt of publications of this Society.

Donations for the Library were announced as follows: From the Imperial Society of Naturalists of Moscow; the

German Geological Society of Berlin; A memoir of the Anniversary of the Stoltzen System of Stenography; the Imperial Royal Geological and the Imperial Royal Geographical Societies at Vienna: the Society of Naturalists of Marburg; the Royal Observatory of Brussels; the Holland Society of Sciences at Harlem; the Royal Academy of Science of Belgium; Pamphlets on various subjects from A. Quetelet and the Belgian Academy; from the Batavian Society of Experimental Philosophy; the Netherland Legation; the Royal Irish Academy; the Royal Geological Society of Ireland; the Literary and Philosophical Society of Manchester; the Royal Society of London, and the Chemical Society of London: the Dublin Quarterly Journal, and the Medical News and Library of Philadelphia.

Judge Sharswood announced the death of Prof. Vethake, a member of the Society, which occurred on the 16th inst., in the 76th year of his age.

Dr. Hayden made some remarks in regard to the geology of the Missouri Valley, and exhibited a section of the Missouri River from the mouth of the Platte River to Fort Benton, and several geological maps of that region.

He called the attention of the Society to the simplicity of the structure of all this Prairie Country. The rocks of the different great periods seemed to lie in basins, as is shown by the colored section. By referring to the map, it will be seen that the coal-bearing rocks are largely developed along the Missouri River, from a point below the mouth of the Kansas River, at Leavenworth City, Nebraska City, and other places; but that by a slight dip towards the north-west, they pass beneath the water-level of the river about 30 miles above Council Bluffs. These rocks do not appear again in their westward extension, until they are revealed by the upheaval of the Rocky Mountains and their outliers, the Black Hills, &c. They are here exposed, by upheaval, with a comparatively diminished thickness, varying from 200 to 1500 feet, forming a narrow belt or zone around the granitic nucleus. Overlying the Carboniferous rocks along the Missouri are a series of formations of Cretaceous age, which have been separated into five divisions, Nos. 1, 2, 3, 4, and 5. Beds of intermediate age are wanting. These formations have also received

special geographical names,\* indicating points where each division is shown in its largest development. No. 1 is called the Dakota group, because it was first described along the Missouri River, near Dakota Territory, and there exhibits its typical characters. No. 2, or Fort Benton group, has a thickness of 800 to 1000 feet near Fort Benton, while along the Missouri River, near the mouth of the Vermilion, where it was first discovered, it never attains a thickness of more than 80 or 90 feet. No. 3 is called the Niobrara group, as it presents its typical characters and is most finely shown along the Missouri, near the entrance of the Niobrara River. No. 4 is named the Fort Pierre group, from the fact that this point is located near the centre of its greatest thickness. No. 5 is denominated the Fox Hills group, from an elevated ridge between Moreau and Grand Rivers, where it contains a great abundance of its characteristic organic remains. This ridge continues a little east of north, crossing the Missouri River near the mouth of Cannon-ball River. All these divisions reappear along the slope of the mountains, showing quite clearly that they dip beneath the Tertiary beds in the basin-like form before described.

Then come the great Tertiary basins, which may be given in the order of their supposed age, commencing with the oldest: 1st. The Judith River Basin occupies an area of about 40 miles in length from east to west, and 15 to 20 from north to south. 2d. The Great Lignite Basin occupies all the country from Heart River to the Musselshell, most of the Valley of the Yellowstone, extends for an unknown distance northward, into the British Possessions, and southward at least to the North Platte, and it is supposed that the Lignite beds near Pike's Peak and Raton Pass, in New Mexico, are of the same age. The limits of this great basin have not yet been strictly defined. 3d. The Wind River deposits occupy an area of about 100 miles in length and 40 to 50 in breadth. 4th. The Basin of the "Mauvaises Terres," or Bad Lands, of White River, cover a vast region, at least 100,000 square miles, and from the scattered hills on both sides of the Missouri River, this great fresh-water lake must have spread over 150,000 square miles. It is supposed, from the evidence already secured, that these lakes were not contemporaneous, but succeeded each other in the order enumerated.

Dr. H. remarked, in regard to the probable existence of Coal in the Coal measure rocks from Leavenworth City to Omaha, he be-

\* Meek and Hayden, Proceedings Academy Nat. Sciences, 1861.

lieved that this portion of the country formed the western rim of the great coal basin, and that the coal beds had so thinned out in their western extension, that no seams will be found thick enough to pay the cost of opening. At Omaha City the Pacific Railroad Company are sinking an Artesian Well several hundred feet, with the hope of passing through a bed of coal, but it is hardly probable that they will succeed.

The Permian rocks of Kansas are also quite instructive. Their organic remains show clearly that these beds are only a prolongation of the Carboniferous period, and as such they are classified in Dana's Manual of Geology. There is no physical break between the well-known Carboniferous beds and those of the Permian; and the well-known Coal measure fossils gradually fade out, and the well-marked Permian forms increase, as you pass upward, until only about 200 feet of rocks contain exclusively Permian forms. This is an important lesson in geology, inasmuch as there seems to be a bridging over of one of the chasms or breaks in the great divisions of the geological scale.

The Dakota group also presents an instructive lesson in the angiosperm dicotyledonous plants, which have been preserved in its strata. It is well known to geologists that up to the present time no well-marked dicotyledonous plants have been found in rocks older than the Cretaceous. The sandstones of this group at Tekama, Blackbird Hill, Sioux City, have yielded a large number of species. Here leaves were first detected by Dr. H. in 1857, at Blackbird Hill. Not long after this time Mr. Meek forwarded some tracings of these leaves to Prof. O. Heer, of the University of Zurich, Switzerland, one of the most eminent authorities in fossil botany in Europe. He at once pronounced them of Tertiary age, and on the strength of that opinion Mr. Marcou published a small memoir, in which he affirmed that Mr. Meek and Dr. H. had confounded strata of different ages, and that the plants must have come from Tertiary rocks.

In 1863, Mr. Marcou, accompanied by an eminent Italian geologist, Prof. Capellini, of the University of Bologna, made a tour to the West, ascending the Missouri River as far as the mouth of the Big Sioux River; and on their return to Europe, published the results of their observations in two small memoirs, in which they both freely acknowledged the correctness of the previous labors of Mr. Meek and Dr. H. Prof. C. made a fine collection of plants from the Dakota group, which he placed in the hands of Prof. Heer, for ex-

amination, who, after a careful study of them, affirmed that these rocks are Cretaceous. Thus a long-disputed point has been set at rest.

The vegetable remains of this formation are peculiarly interesting to the geologist, from the fact that among them are forms so closely resembling the leaves of the fruit and forest trees of the present time,—a very marked and important advance in the progress of the vegetation of the ancient world. So far as can be seen from the collections already made, they do not seem to exhibit as high a type of organization as those of the same class of the present day. There seem to be no serrations on the edges of the leaves or other attempts at ornamentation, which are so finely shown in those of our living forest trees. The inference is, therefore, that this flora illustrates the great law of progress: commencing with great simplicity of form, and advancing, step by step, to greater complexity and beauty.

Dr. H. also spoke of the interesting fossils he had collected during the past season from the Fort Pierre group, at Sage Creek and other localities in that vicinity. These fossils are so abundant at certain localities, extending in continuous lines or belts for long distances across the country, and so well preserved, that one might regard these shell zones as the shores of the great Cretaceous sea.

Dr. H. also exhibited some thin slabs of fine-grained ferruginous sandstone, from the head-waters of the Teton River, eastern side of the Bad Lands. They belong to the upper part of the Fox Hills group, near the close of the Cretaceous period of the Upper Missouri. They were covered with very distinct trails of gasteropoda and marine worms. These specimens seem to indicate a shore-line, from which there was an ebb and flow of the tide, and as the waters receded these little animals left behind, would struggle over the soft sand toward the water, leaving their peculiar trails, which would be filled up with sediment by the returning tide.

The fact of the existence of four and perhaps five great fresh-water lakes in the Upper Missouri country during the Tertiary period, is a matter of the highest interest, and it is our privilege to collect all the evidence possible, and thus restore to our minds the ancient physical geography of this region. We cannot doubt that during all the different geological epochs there were lakes, rivers, seas, and oceans, islands, continents, and mountains, and that it is the most important mission of the geologist to restore the physical geography of these different epochs to the eye of science.

Prof. Cresson made some remarks upon the great fall of temperature that occurred the day previous to the meeting, accompanied by a sudden rise of the barometer, similar to that observed on the 7th and 8th of January of this year, when these phenomena were exhibited over a large extent of territory, embracing all the Northern and Middle States of the Union.

He also described a curious effect of the extreme cold, observed by him this morning in Schuylkill County, where the thermometer stood at  $15^{\circ}$  below zero of Fahr. Just after daybreak he saw the steam thrown off by the large engines of a colliery rising in a vertical column of dense cloud some 300 feet or more in height, and then float off horizontally from the top of the column in a stratum some two or three miles long, where it rested, without much change of level, for a long time.

The phenomenon being, in his opinion, the result of the sudden freezing of the vesicular mass and the entanglement in it of a quantity of air, of which the temperature was so much higher than that of the surrounding atmosphere, to keep the whole afloat, as he supposed to be the case in most of the lofty mackerel clouds.

The Committee of Finance made their report, and recommended the usual appropriations for the expenses of the Society during the ensuing year, which were adopted.

Pending nominations Nos. 552 to 567 were read.

And the Society was adjourned.